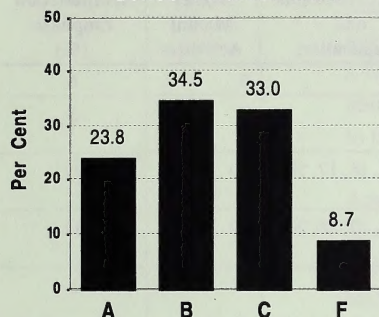


Biology 30

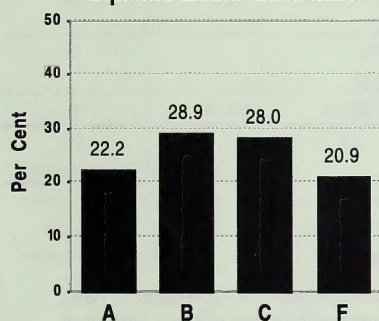
Diploma Examination Results

Examiners' Report for June 1993

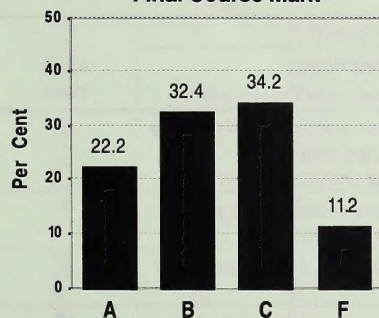
School-Awarded Mark



Diploma Examination Mark



Final Course Mark



The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the June 1993 administration of the Biology 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Biology 30 Diploma Examination consists of two parts: a multiple-choice section of 70 questions worth 70% and a written-response section of four questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 12 050 students in Alberta who wrote the June 1993 examination. This represents an increase of 580 students compared to June 1992.

- 88.8% of these students achieved the acceptable standard (a final course mark of 50% or higher).
- 22.2% of these students achieved the standard of excellence (a final course mark of 80% or higher).

Generally, student achievement in Biology 30 was satisfactory. Compared to June 1992, there was an increase (86.1 to 88.8) in the percentage of students who achieved the acceptable standard. Most students demonstrated a good understanding of cellular processes and function of human organ systems. Some students demonstrated outstanding creative ability to make connections between concepts of human physiology and technology.

Provincial Averages

- The average school-awarded mark was 67.6%.
- The average diploma examination mark was 64.4%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 66.4%.

Results and Examiners' Comments

Subtest: Machine Scored

When analyzing detailed examination results, please bear in mind that subtest results **cannot** be directly compared.

Results are in average raw scores.

Machine Scored: 49.4 out of 70

Course Content

- Cellular Processes: 4.0 out of 6
- Homeostatic Mechanisms: 2.3 out of 3
- Nutrition and Digestion: 8.1 out of 11
- Body Fluids: 7.9 out of 11
- Breathing, Gas Exchange, and Transport: 3.5 out of 5
- Energy Release: 2.2 out of 3
- The Kidney: 5.2 out of 8
- Regulation of the Internal Environment: 9.4 out of 13
- Voluntary Movement and Body Support: 1.3 out of 2
- Human Reproduction: 5.4 out of 8

Process Skills: 9.8 out of 14

- Multiple-choice questions 5, 6, 8, 14, 17, 19, 27, 28, 32, 36, 47, 56, 58, and 63

Cognitive Levels

- Knowledge: 18.4 out of 25
- Comprehension and Application: 24.3 out of 35
- Higher Mental Activities: 6.7 out of 10

Subtest: Teacher Scored

Results are in average raw scores.

Teacher Scored: 14.9 out of 30

Written-Response Questions

- Question 1: 5.3 out of 10
- Question 2: 2.6 out of 5
- Question 3: 1.6 out of 5
- Question 4: 5.3 out of 10

Machine-Scored Blueprint (Multiple Choice)

Each question in this section is classified in two ways: according to the curricular content area being tested and according to the cognitive level demanded by the question. The examination blueprint illustrates the distribution of questions in June 1993 according to these classifications.

Course Content	Machine Scored			Examination Emphasis (%)
	Knowledge	Comprehension and Application	Higher Mental Activities	
Cellular Processes	1, 2	3, 4, 5	6	6
Homeostatic Mechanisms	7	8	9	3
Nutrition and Digestion	10, 11, 12, 13	14, 15, 16, 17, 18, 19	20	11
Body Fluids	21, 23, 24, 25	22, 26, 27, 28, 29, 30	32	11
Breathing, Gas Exchange, and Transport	31, 33	34, 35	36	5
Energy Release	37	38	39	3
The Kidney	40, 41, 42	43, 44, 45, 46	47	8
Regulation of the Internal Environment	48, 49, 51, 52, 53	50, 54, 55, 56, 57, 59, 60	58	13
Voluntary Movement and Body Support	61	62		2
Human Reproduction	64, 67	63, 65, 68, 69	66, 70	8
Examination Emphasis(%)	25	35	10	70

Teacher-Scored Blueprint (Written Response)

Each question in this section is designed to measure student achievement of two or more course objectives. Furthermore, students are expected to use a variety of cognitive skills to construct satisfactory responses. The examination blueprint illustrates the distribution of questions in June 1993 according to these classifications.

Question Number	Teacher Scored	Mark Value
	Question Description (Concept, Cognitive Levels, and Process Skills)	
1	Perceiving possible relationships indicative of the body as an ecological unit. Applying examples of technology. Communicating clearly and logically.	10
2	Identifying and describing homeostatic functional relationships between organ systems.	5
3	Predicting and justifying outcomes of investigations in stomach function.	5
4	Interpreting experimental data, identifying and describing relationships between variables, and generating ideas for extending knowledge.	10
Total		30

This examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard will obtain a mark of 50% or higher and students capable of achieving the standard of excellence will obtain a mark of 80% or higher. This examination is parallel in structure to the January 1993 Biology 30 examination, but is different in structure from the June 1992 Biology 30 examination in that it contains four instead of five written-response questions, for a total of 30 marks. The maximum value of any one written-response question is 10 marks. The four questions require students to use a variety of thinking skills, all of which go beyond, but are not isolated from, the ability to recall core concepts. One question requires students to relate technology to the development of science concepts.

Approximately 12.8% of the students who wrote the examination in June 1993 and received a school-awarded mark had written at least one other Biology 30 Diploma Examination during the January 1992 to January 1993 period. This subpopulation (1 537) achieved an examination average of 59.0%, compared to 65.2% for the population (10 513) whose first writing of a Biology 30 examination was in June 1993. However, the group of students who rewrote (1 537) increased their examination average score from 48.2% to 59.0%.

Approximately 58.0% of the students who wrote the examination were female. Approximately 77.2% of this female population achieved the acceptable standard on the examination, compared to 81.8% of the male population.

Multiple Choice

Question	Key	Difficulty*	Question	Key	Difficulty	Question	Key	Difficulty
1	C	74.4	25	C	81.5	49	C	59.4
2	D	80.0	26	D	59.6	50	C	64.0
3	D	77.0	27	B	77.9	51	A	64.4
4	C	71.3	28	A	64.4	52	C	65.7
5	A	49.5	29	C	67.5	53	B	77.3
6	B	49.7	30	C	75.1	54	A	69.5
7	D	72.7	31	B	88.3	55	A	77.7
8	B	81.0	32	B	56.2	56	C	77.2
9	D	71.1	33	A	72.8	57	C	82.5
10	D	67.5	34	A	51.8	58	C	74.0
11	B	77.3	35	B	71.8	59	D	78.2
12	A	68.4	36	D	68.1	60	B	70.3
13	B	76.2	37	D	79.2	61	C	57.7
14	A	54.2	38	A	78.3	62	B	73.4
15	C	89.1	39	A	64.9	63	C	78.0
16	A	70.3	40	B	72.1	64	B	77.5
17	C	86.4	41	C	68.3	65	C	59.3
18	C	61.0	42	A	80.4	66	B	78.9
19	D	87.9	43	B	71.9	67	B	70.9
20	D	73.6	44	B	50.7	68	D	51.2
21	A	75.1	45	D	33.8	69	B	68.9
22	A	80.0	46	C	71.2	70	D	59.3
23	D	94.1	47	B	71.5			
24	C	55.5	48	B	82.9			

*Difficulty—percentage of students answering the question correctly

Machine-Scored Section

(Multiple-Choice Questions)

For a complete breakdown of student responses by alternative for the multiple-choice questions, please refer to the school and jurisdiction reports.

Most students who achieved the acceptable standard interpreted experimental data that was presented in simple graphs or tables (questions 8, 17, and 19). They translated into words symbolic representations of biological functions (questions 9 and 38). They recognized and provided definitions for biological terms (questions 7, 41, and 42). They sequentially ordered the major steps of physiological processes (questions 50 and 57) and traced pathways that materials follow through the body (questions 27 and 63). They understood basic functions of human body structures as assessed by many questions, but many of these students did not know the properties of some key biological substances (questions 24, 49, and 61). Most of these students found it difficult to interpret simple laboratory tests (questions 6 and 14).

**Percentage of Students Correctly Answering
Selected Machine-Scored Questions**

Student Group	Question Number			
	6	28	35	49
All students	49.7	64.4	71.8	59.4
A (80% or higher)	83.5	85.8	94.2	84.7
C (50% to 64%)	34.1	58.2	64.8	50.5
F (less than 50%)	21.3	39.2	43.1	32.5

Students who achieved the standard of excellence, in addition to fulfilling the expectations identified above, interpreted interrelated sets of data presented in complex tables or graphs (questions 28, 32, 36, and 47). They analyzed multistep human physiological problems (questions 18, 29, and 70). They formed correct inferences from extracurricular data (questions 35 and 46). Most of these students identified significant parts of human tissues or organs and recognized their specialized functions (questions 26, 43, 44, and 45).

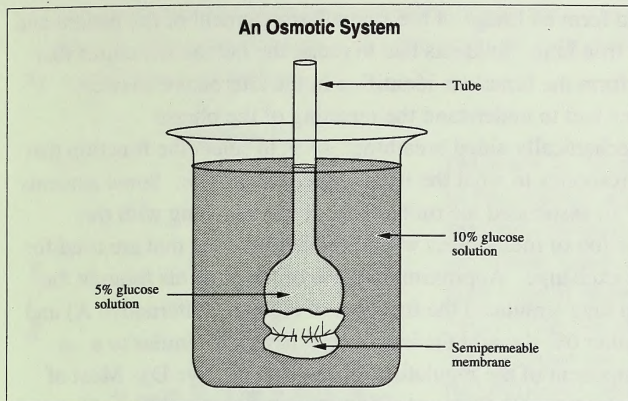
Detailed statistics and comments follow on four questions.

49. Which statement about hormones is accurate?

- A. Hormones cause an instantaneous stimulating effect.
- B. Hormones stimulate only one target organ or group of cells.
- C. Hormones are transported from endocrine glands by the circulatory system.
- D. Hormones are produced by the central nervous system and stored in exocrine glands.

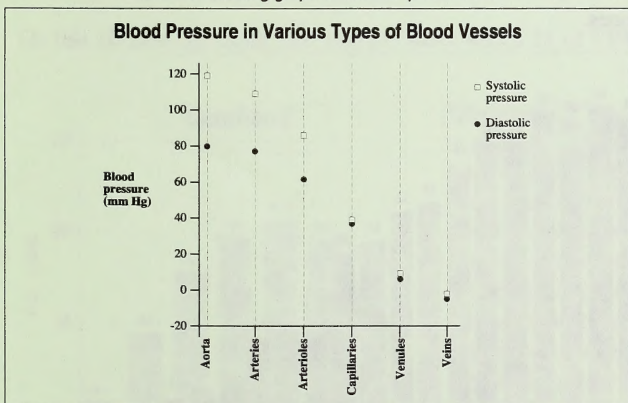
Question 49 required students to know the meaning of terms used to classify glands (endocrine, exocrine, target) and to know the general characteristics of hormones. This question was difficult for those students who did not distinguish between making a generalization about a class of substances and identifying the properties of a single example. Many students did not understand that some hormones like thyroxine and growth hormone affect almost all cells of the body in contrast to other hormones that only affect a specific organ or tissue (23.8% chose alternative B). Some students did not understand that the action of some hormones like thyroxine may require several hours or days before initial activity begins, whereas other hormones, such as adrenaline, take effect within minutes (9.6% chose alternative A). A small number of students did not understand that, before their release, hormones may be stored in the endocrine tissues that produce them, not in other tissues that receive them, such as exocrine glands (7.2% chose alternative D).

Use the following diagram to answer question 6.



6. Which of the following statements **best** describes what will happen in this osmotic system?
- A. The solution level in the tube will rise because water will move across the semipermeable membrane from the 10% glucose solution to the 5% glucose solution.
 - B. The solution level in the tube will drop because water will move across the semipermeable membrane from the 5% glucose solution to the 10% glucose solution.
 - C. The solution level in the tube will remain the same because every water molecule moving out of the tube across the semipermeable membrane will be replaced by a glucose molecule moving into the tube.
 - D. The solution level in the tube will rise as water moves across the semipermeable membrane from the 10% glucose solution to the 5% glucose solution, and then the level will drop as the concentration of glucose molecules begins to even out.

Use the following graph to answer question 28.



28. Which statement is a logical inference based on this graph?
- A. The blood pressure causing the filtration of fluids out of the capillaries in the glomerulus remains nearly the same during systole and diastole.
 - B. The drop in blood pressure from arterioles to capillaries is caused by an increase in blood vessel diameter.
 - C. Vessels with the greatest difference between systolic and diastolic pressures are farthest from the heart.
 - D. Less blood is lost from a severed artery than from a severed vein of a similar size.

Question 6 required students to analyze the design of the osmotic system and predict the change over time in fluid level in the tube. Their prediction should have been based on an understanding of diffusion gradients as established by a semipermeable membrane. The osmotic system offered an analytical challenge in that the concentrations of the solutions in the tube and beaker were opposite in relative amounts to what is usually used in classroom demonstrations. Many students (42.2%) chose alternatives A and D, which predicted the result expected if the solute concentrations were parallel to those used in common models. Students who did not understand the concept of diffusion gradient and how this relates to the net movement of water would have also been drawn to these two alternatives. A misconception of osmosis as described in alternative C attracted 8.1% of the students. However, most students (83.5%) who achieved the standard of excellence on the examination demonstrated good analytical skills as well as an understanding of osmosis.

Question 28 required students to interpret a graph and then integrate their understanding of heart function with their understanding of blood pressure and blood vessel characteristics. Students demonstrated evidence of having read the graph. Based on the distribution of choices, it was evident that most students selected responses with intent and did not guess. However, many students (35.6%) did not have adequate knowledge of the special characteristics of each kind of blood vessel or else they had difficulty integrating the various isolated facts they could recall. These students did not understand how vessel characteristics change sequentially in the circulatory system. Approximately 21% thought that capillaries are larger in diameter than are arterioles (alternative B). Approximately 9% thought that the aorta and arteries are farther from the heart than are venules and veins (alternative C). Approximately 6% did not understand the relationship between pressure, volume, and time (alternative D). Approximately 62% of the female population selected the keyed response (A) whereas 68% of the male population selected the keyed response.

Mechanically Aided Breathing

Before the development of a preventive vaccine, polio caused paralysis in many people. If paralysis extended to the upper body, a patient was placed inside an *iron lung*, which mechanically aided breathing. The *iron lung* was an airtight chamber with a rubber seal that fit around the patient's neck. Only the head of the patient was outside the machine.

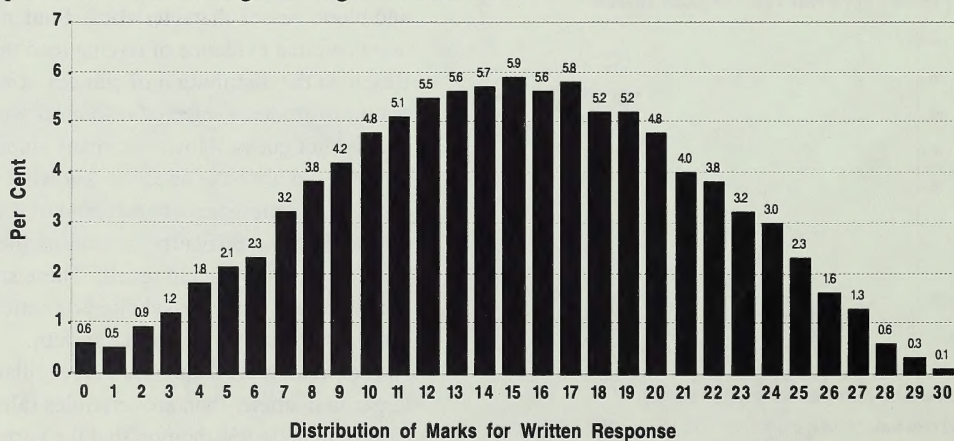
35. The function of the iron lung was to
- A. filter, moisten, and warm inhaled air
 - B. change air pressure around the chest cavity
 - C. provide an artificial membrane for gas exchange
 - D. stimulate the breathing centre in the medulla oblongata

Question 35 required students to read carefully the context and then form an image of the spatial arrangement of the patient and the iron lung. Students had to recall the human structures that perform the functions identified in the alternative answers. They had to understand the meaning of the phrase “mechanically aided breathing” so as to select the function that corresponds to what the iron lung could imitate. Some students (16%) associated the rubber seal of the iron lung with the function of membranes within the human lung that are used for gas exchange. Approximately 6% of the students thought the iron lung simulated the function of the nose (alternative A) and another 6% thought the iron lung functioned similar to a component of the regulatory system (alternative D). Most of the students (71.8%) understood the mechanics of breathing and therefore selected the keyed response. However, a significant gender difference was evident in that 65.3% of the female population selected the keyed response in comparison to 80.7% of the male population.

Teacher-Scored Section

(Written-Response Questions)

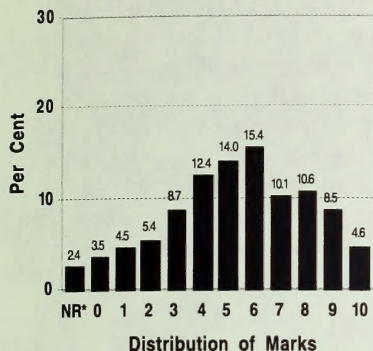
The four questions in the written-response section provided students with a variety of assessment tasks. In responding to Question 1, students were free to draw on their areas of expertise to explain and illustrate the conservation of matter and energy within the human body. Question 2 was a little more restrictive in that it required students to demonstrate their understanding of five specific human body systems and how these systems interrelate. Question 3 was very specific in that it required a detailed understanding of the function of one human body organ. Finally, in Question 4, students were expected to draw on their understanding of process skills as developed throughout the Biology 30 course. A review of the distribution of scores on each of these written-response questions revealed no significant gender differences.



Responses to the written-response section indicated that most students approached the examination seriously and made a commendable effort. All four questions were attempted by 94.9% of the students and very few (0.3%) did not attempt any of the four questions. A few students (0.1%) achieved full marks on each of the four questions. However, approximately 47.3% of the students obtained less than 15 marks out of 30 on the written-response section. Many students presented general answers that lacked the specific details required for full marks. This was particularly evident for Question 3.

Although the average score on the written-response section was considerably lower than on the multiple-choice section (49.7% compared to 70.6%), the marks on both sections of the examination showed a high correlation with the school-awarded marks.

Question 1



*NR—No Response

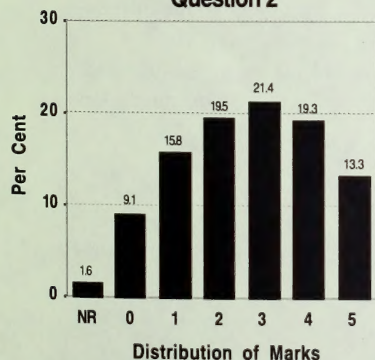
Question 1: Most students (94.1%) obtained at least one mark and 23.7% of the students obtained eight or more marks for this question. Many students demonstrated creative thinking skills in identifying and explaining examples of “two Rs.” These students also demonstrated a high level of knowledge and thus were able to make logical connections between the concepts of human physiology and technology. Recognition that enzymes are re-used was a very common response. Some students had difficulty distinguishing between “recycle” and “re-use” and therefore unwittingly presented two examples of the same R. Many students did not understand the meaning of substance and therefore described the reuse of an organ or system, e.g., organ transplants. Some students confused the reuse of energy with the re-use of a substance, e.g., glucose.

It was evident that many students had gained a good understanding of the meaning of technology. Some students, however, seemed to have the misconception that they had to choose sophisticated examples, e.g., dialysis machine. Many students named technologies but did not explain how their choices assisted the body to reduce or re-use a substance or energy.

Many students addressed all parts of the question and organized their responses in paragraphs. However, some students seemed to have trouble working within the open framework. Perhaps they had come to rely on outside factors to assist them in organizing their thinking and communicating processes. Written communication skills on the whole have improved over the past several examination periods. However, some students are limited to expressing only vague generalities because they do not have adequate background knowledge of human physiology.

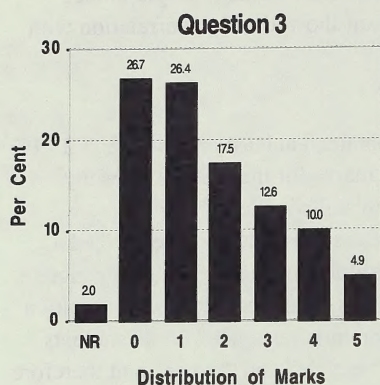
On this 10-mark question, the average mark was 5.31 or 53%.

Question 2



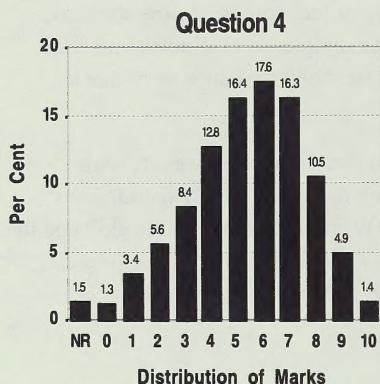
Question 2: Knowledge of five major human body systems was required to explain how one of the five systems assisted another to maintain homeostasis. Approximately 33% of the students understood the functions of four or all five of these systems well enough to provide an excellent set of explanations. However, approximately 46% of the students could explain a maximum of only two of the five interrelationships between systems. Either this group lacked sufficient knowledge or they did not respond to the “How?” directive with sufficient clarity and precision. Comments collected from the markers support both explanations. These students, who failed to achieve the acceptable standard on this question, did not provide enough details, did not use correct scientific terminology, and often confused relationships between causes and their effects. They also demonstrated poor understanding of physiological concepts, e.g., the nervous system controls levels of carbon dioxide and oxygen in the circulatory system to control the breathing system.

On this 5-mark question, the average mark was 2.63 or 53%.



Question 3: An understanding of the functions of the stomach was required to answer this question, which was set in an historical and experimental context. Correct identification of the major organic components of the food samples was also required to predict the outcome of each investigation. Most students demonstrated a fairly good knowledge of the digestive system, but their skills in communicating this knowledge were poor. They did not know how to justify an answer; that is, they did not give facts about the function of the stomach that supported their position. They described instead what took place in structures other than the stomach, then concluded that the food in question was not digested in the stomach; e.g., starch is digested in the mouth and small intestine, therefore not in the stomach. Most students were able to explain that pepsin digests the protein in lean meat, but then did not know what was in each of the other food samples; e.g., beef fat is a protein, cellulose is a lipid.

On this 5-mark question, the average mark was 1.63 or 33%.



Question 4: Most students (65.7%) demonstrated an acceptable understanding of the processes used in solving problems scientifically. They could interpret the data provided and therefore identify the relationships between neonatal death and average blood-glucose levels (part a). They presented at least one reasonable effect that low glucose levels could have on the health of young monkeys (part b). If this part was poorly answered, it was usually because the student confused the relationship between cause and effect. Most students could evaluate the design of the investigation and identify advantages and disadvantages of the two types of blood tests (part c). Most students demonstrated an acceptable understanding of the concept of fixed variables and therefore could identify at least one factor that the researchers must have regulated (part d).

Very few students presented an acceptable response for *part e*. Most students did not understand the difference between a factor functioning as a direct cause and as an indirect or accompanying phenomenon. Many students indicated that if low glycosylated Hb was not the direct cause, then neither was low blood sugar the direct cause. A few students, using divergent thinking skills, contributed interesting interpretations, e.g., glucose functioned as a competitive inhibitor for oxygen's site on the hemoglobin.

Most students could present at least one application for the diagnosis of human glandular diseases from the tests used in the investigation (part f). Diabetes mellitus was frequently presented along with diabetes insipidus. Diabetes insipidus was incorrectly identified with glucagon deficiency. Other glandular disorders were correctly related to glucose metabolism, e.g., hypoglycemia, goiter, cirrhosis.

On this 10-mark question, the average mark was 5.34 or 53%.

For further information, contact Lowell Hackman or Phill Campbell at the Student Evaluation Branch, 427-0010.